VSTOL Ground Effects Characterization and Control

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HPC Computer Resource: SGI Origin 2000 [ASC MSRC, ARL MSRC]

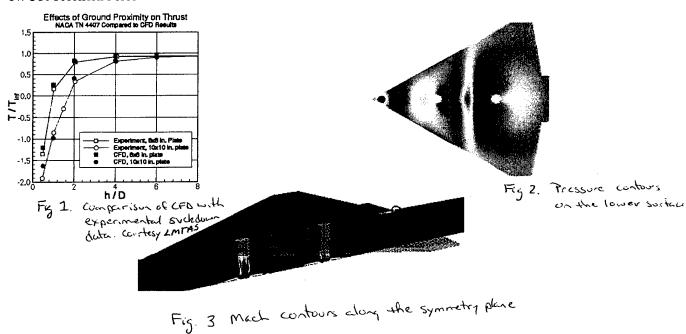
Research Objective: Develop and validate a numerical method using computational fluid dynamics (CFD) for the prediction of VSTOL ground effects flow fields. Use the validated computational prediction method to explore flow control devices designed to limit lift loss due to suckdown and hot gas ingestion and to limit landing area heating and acoustic levels.

Methodology: Two CFD approaches were explored with two different CFD codes, USM3D and Overflow, which use unstructured and chimera-structured grids, respectively. The CFD codes were validated against existing experimental data including simple flat plate studies and more complex multiple jet delta wing studies. The approach that shows the best agreement with experimental data will then be used to explore various control device concepts designed to reduce or eliminate the adverse characteristics associated with VSTOL aircraft flight in ground effect.

Results: Initial comparisons with experimental data for simple flat plate cases showed promising results, fig. 1. Comparison with experimental data for the more complex delta wing case has not yet been completed. Surface pressure results, fig. 2, and Mach contours along the symmetry plane, fig. 3, from the Overflow code indicate all the expected features such as the fountain effect between the two jets.

Significance: A validated CFD tool is essential for the expedient and accurate prediction of forces and moments experienced by a VSTOL aircraft flying in ground effect. A validated computational method would also greatly reduce design cycle time and cost by providing a fast and reliable test bed for parametric design changes. Ground effect flow control devices have the potential to greatly affect all of the following areas: thrust and fuel requirements for take off and landing, aircraft stability, landing area erosion, ground crew safety, etc.. This, in turn, has the potential to significantly reduce overall life cycle cost.

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REPORT DOCUMENTATION PAGE				OMB No. 0704-0188		
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ADDRESS. 1. REPORT D.	ATF	2. REPORT T	YPE	3. DATES COV	ERED	
1. KLI OKI D	AIL .	Professional		5. 2 . 11. 25		
4. TITLE AND SUBTITLE				5a. CONTRACT NUMBER		
VSTOL Ground Effects Characterization and Control				5b. GRANT NUMBER		
15102 Grand Ericols Characterization and Condo.				5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S)				5d. PROJECT NUMBER		
Susan A. Polsky				5e. TASK NUMBER		
				5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)				8. PERFORMING ORGANIZATION REPORT NUMBER		
Naval Air Warfare Center Aircraft Division 22347 Cedar Point Road, Unit #6 Patuxent River, Maryland 20670-1161					·	
9. SPONSORING/MONITORING AGENCY NAME(S) AND				10. SPONSOR/MONITOR'S ACRONYM(S)		
ADDRESS(ES)						
N 1410 () () ()				11. SPONSOR/MONITOR'S REPORT NUMBER(S)		
Naval Air Systems Command 47123 Buse Road Unit IPT						
Patuxent River, Maryland 20670-1547						
12. DISTRIBUTION/AVAILABILITY STATEMENT						
Approved for public release; distribution is unlimited. 13. SUPPLEMENTARY NOTES						
13. SOIT ELMENTANT NOTES						
14. ABSTRACT						
Description of VSTOL ground effects flow fields						
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ingestion and to limit landing area heating and acoustic level.						
15. SUBJECT TERMS						
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON Susan Polsky	
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. TELEPHONE NUMBER (include area	
					code)	
Unclassified	Unclassified	Unclassified	Unclassified	1	(301) 342-8575	

Unclassified

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